

Super Lattice Formation of an Array of Growing Wetting Droplets

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An ordered array of wetting droplets which grow out of supersaturated gas phase or dissolve into a subsaturated one will be discussed. The droplet array is built on a structured substrate, where there is a lattice of equal circular hydrophilic patches on a hydrophobic wall. The droplets grow (or shrink) by condensation or evaporation. There is an Ostwald ripening type competition process between large and small droplets, where the large ones get fed via diffusion by the small ones due to the difference in the boundary condition to the surrounding concentration field. This provides a long-range interaction between the droplets. The effect can lead to an instability in a formerly uniform droplet array. A super lattice builds up. A description of this super lattice formation will be presented using a quasistatic approximation of the diffusion equation. Dispersion relations of the possible instabilities will be given. For experimental purposes, it is important to relate to growth rate of the super lattice formation to the overall growth or shrinkage of the droplet array. This problem will be treated for different external boundary conditions, and the effect of the degree of supersaturation (or subsaturation) will be analyzed. We use a rather general approach, but look at square and triangular lattices in detail.